

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



San Antonio Missions National Historical Park

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic
Data for San Antonio Missions National Historical Park

saan_geology.pdf

Version: 2/22/2022

Geologic Resources Inventory Map Document for San Antonio Missions National Historical Park

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Geologic Resources Inventory Map Document



San Antonio Missions National Historical Park, Texas

Document to Accompany Digital Geologic-GIS Data

[saan_geology.pdf](#)

Version: 2/22/2022

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for San Antonio Missions National Historical Park, Texas (SAAN).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

- 1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.
- 2) **GRI Digital Maps and Source Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.
- 3) **Digital Geologic-GIS Map of San Antonio Missions National Historical Park and Vicinity**
 - a) **Geologic Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.
 - b) **Geologic Map Unit Descriptions** – Descriptions for all geologic map units.
- 4) **Digital Environmental Geologic-GIS Map for San Antonio Missions National Historical Park and Vicinity**
 - a) **Environmental Geologic Map Unit List** – A listing of all environmental geologic map units present on maps for this project.
 - b) **Environmental Geologic Map Unit Descriptions** – Descriptions for all environmental geologic map units.

- 5) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.
- 6) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <https://www.nps.gov/articles/gri-geodatabase-model.htm>

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: <https://go.nps.gov/gripubs>. GRI digital geologic-GIS data is also available online at the NPS Data Store: <https://irma.nps.gov/DataStore/Search/Quick>. To find GRI data for a specific park or parks select the appropriate park(s), enter "GRI" as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <https://www.nps.gov/subjects/geology/gri.htm>. At the bottom of that webpage is a "Contact Us" link if you

need additional information. You may also directly contact the program coordinator:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: <https://www.nps.gov/im/inventories.htm>.

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for San Antonio Missions National Historical Park, Texas (SAAN):

Digital Geologic-GIS Map of San Antonio Missions National Historical Park and Vicinity, Texas (GRI MapCode SAAN)

The GRI used only a portion of the source map listed below and captured geologic contacts, map symbology and mine point features from the source map.

Barnes, V.E., 1982, Geologic Atlas of Texas: San Antonio Sheet (Robert Hamilton Cuyler Memorial Edition): Texas Bureau of Economic Geology, University of Texas at Austin, Geologic Atlas of Texas 29, scale 1:250,000 ([Geologic Atlas of Texas, San Antonio Sheet](#)). (GRI Source Map ID 2879).

The GRI used only a portion of the source digital data listed below and used it to attribute polygons and capture faults.

Texas Water Development Board, 2007, Geologic Database of Texas: 1:250000 Geologic Data for Beaumont Sheet, Adapted from Barnes, V.E., et al., 1968, Geologic Atlas of Texas, Beaumont Sheet: Texas Bureau of Economic Geology, scale 1:250,000 ([Geologic Data for Beaumont Sheet](#)). (GRI Source Map ID 75030).

Digital Environmental Geologic-GIS Map for San Antonio Missions National Historical Park and Vicinity, Texas (GRI MapCode SAAN_environmental)

The GRI used the full extent of the source maps listed below and captured all geologic features.

Texas Bureau of Economic Geology, 1985, Dewees 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Dewees Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75194).

Texas Bureau of Economic Geology, 1985, Elmendorf 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Elmendorf Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75188).

Texas Bureau of Economic Geology, 1985, Floresville 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Floresville Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75191).

Texas Bureau of Economic Geology, 1985, Losoya 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Losoya Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75193).

Texas Bureau of Economic Geology, 1985, San Antonio East 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([San Antonio East Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75186).

Texas Bureau of Economic Geology, 1985, San Antonio West 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([San Antonio West Quadrangle \(Environmental](#)

[Geology](#)). (GRI Source Map ID 75187).

Texas Bureau of Economic Geology, 1985, Saspamco 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Saspamco Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75192).

Texas Bureau of Economic Geology, 1985, Southton 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Southton Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75189).

Texas Bureau of Economic Geology, 1985, Terrell Wells 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 ([Terrell Wells Quadrangle \(Environmental Geology\)](#)). (GRI Source Map ID 75190).

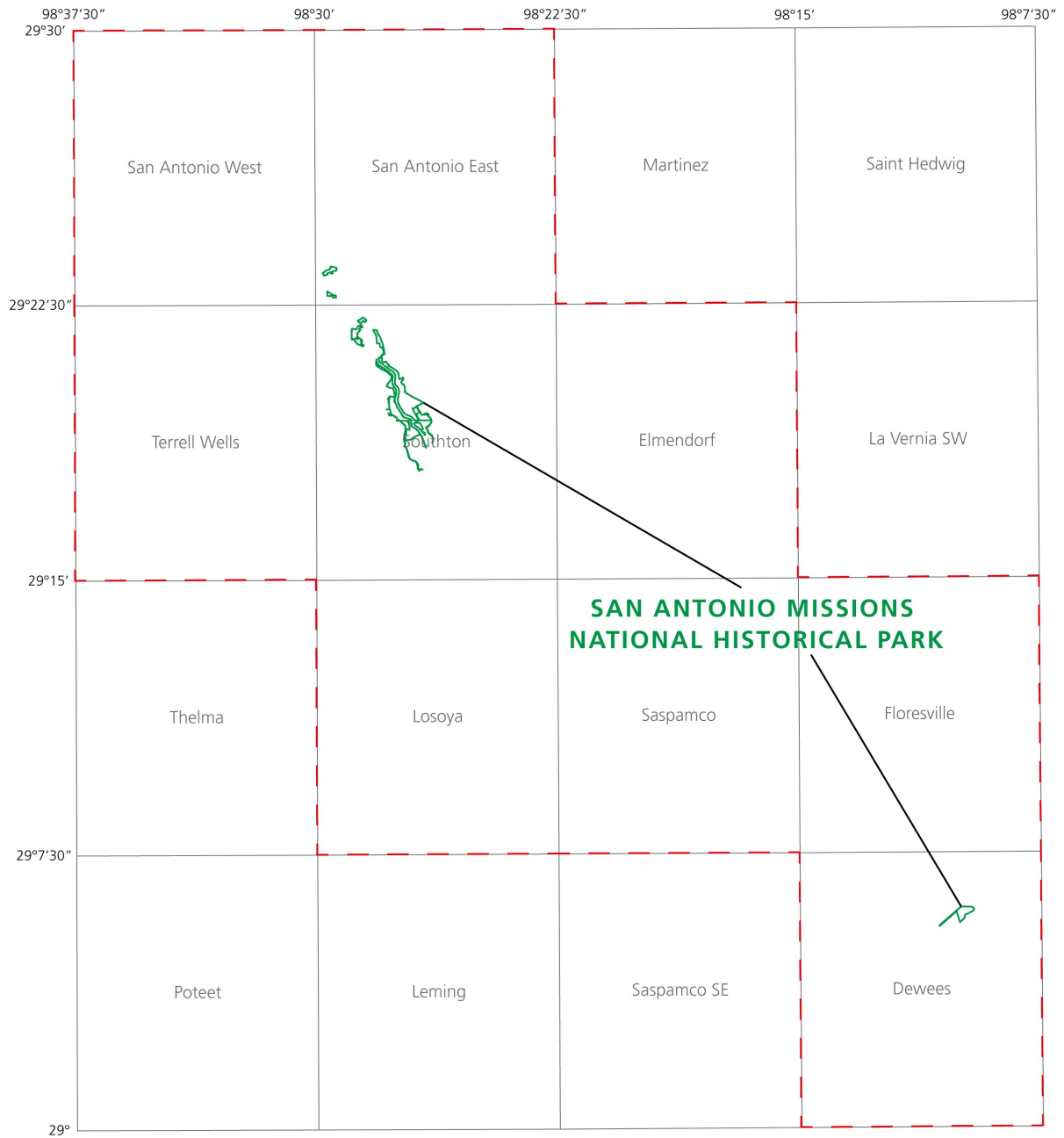
The GRI only used the source map listed below for unit descriptions.

Wermund, E.G., et al., 1985, San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000 ([San Antonio East Llano East Environmental Geology Sheet](#)). (GRI Source Map ID 69844).

Additional information pertaining to each source map is also presented in the GRI Source Map Information (SAANMAP) table included with the GRI digital geologic-GIS data.

Index Map

The following index map displays the extent of the GRI digital geologic-GIS maps produced for San Antonio Missions National Historical Park (SAAN) outlined with a dashed red line. The boundary for San Antonio Missions National Historical Park (as of February 2022) is outlined in green.



Index map by James Winter (Colorado State University)

Digital Geologic-GIS Map of San Antonio Missions National Historical Park and Vicinity

Geologic Map Unit List

The geologic units present in the digital geologic-GIS data produced for San Antonio Missions National Historical Park, Texas (SAAN) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qal - Alluvium). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (SAANUNIT) table included with the GRI digital geologic-GIS data. Some source unit symbols, names and/or ages may have been changed in this document and in the GRI digital geologic-GIS data. This was done if a unit was considered to be the same unit as one or more units on other source maps used for this project, and these unit symbols, names and/or ages differed. In this case a single unit symbol and name, and the unit's now recognized age, was adopted. Unit symbols, names and/or ages in a unit descriptions, or on a correlation of map units or other source map figure were not edited. If a unit symbol, name or age was changed by the GRI the unit's source map symbol, name and/or age appears with the unit's source map description.

Cenozoic Era

Quaternary Period

[Qal](#) - Alluvium

[Qt](#) - Fluvial terrace deposits

[Qle](#) - Leona Formation

[QTu](#) - Uvalde Gravel

Paleogene Period

[Ey](#) - Yegua Formation

[Ecm](#) - Cook Mountain Formation

[Es](#) - Sparta Sand

[Ew](#) - Weches Formation

[Egc](#) - Queen City Sand

[Er](#) - Reklaw Formation

[Ec](#) - Carrizo Sand

[Ewi](#) - Wilcox Group

[Emi](#) - Midway Group

Mesozoic Era

Cretaceous Period

[Knm](#) - Navarro Group and Marlbrook Marl, undivided

[Kpg](#) - Pecan Gap Chalk

[Kau](#) - Austin Chalk

Geologic Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. All descriptions from source map: [Geologic Atlas of Texas, San Antonio Sheet](#)

Qal - Alluvium (Holocene)

Floodplain deposits.

Qt - Fluvial terrace deposits (Pleistocene)

Fine calcareous silt grading down into coarse gravel; type locality first wide terrace of Nueces and Leona Rivers below level of Uvalde Gravel. May correlate with Onion Creek Marl of Austin Sheet.

Qle - Leona Formation (Pleistocene)

Gravel, sand, silt, and clay; adjacent to Edwards Plateau, predominantly gravel, limestone and chert; southeastward in vicinity of Tertiary rocks, increasing amounts of sand, silt, and clay; contiguous terraces are separated by a solid line. Includes "Leona Formation: defined as first wide terrace of Nueces and Leona Rivers below level of Uvalde Formation; the Leona may correlate with Onion Creek Marl of Austin Sheet.

QTu - Uvalde Gravel (Pleistocene or Pliocene)

Caliche-cemented gravel; some boulders up to one foot in diameter; well-rounded cobbles of chert, some cobbles of quartz, limestone, and igneous rock; occupies topographically high areas not associated with present drainage; forms extensive deposits in Medina and Uvalde Counties; may correlate with Willis Formation of Seguin Sheet; thickness ranges from several feet of gravel lag to 20± feet. Most intervening scarps between the Uvalde Gravel and the Leona Formation are covered by several feet of gravel slope wash.

Ey - Yegua Formation (Eocene)

Sandstone and clay; sandstone, mostly quartz, some chert, fine grained, indurated to friable, calcareous, glauconitic, massive, laminated, crossbedded, produces loose, ferruginous yellow-orange and reddish-brown soil; clay, lignitic, sandy, bentonitic, silty, mostly well laminated, chocolate brown to reddish brown, lighter colored upward, produces dark gray soil; some fossil wood; thickness 1000± feet.

Ecm - Cook Mountain Formation (Eocene)

Clay and sandstone; clay gypsiferous, slightly silty and lignitic, minor glauconite, brown to brownish gray, weathers brownish gray to yellowish gray; sandstone near top and at base, very fine grained, calcareous, glauconitic, gray to yellowish brown, marine megafossils and microfossils abundant; thickness 230± feet.

Es - Sparta Sand (Eocene)

Quartz sand, very fine to fine grained, well sorted, micaceous, some silty clay partings and interbedded siltstone, light gray to pale orange to grayish brown; weathers yellowish brown to reddish brown; thickness about 130 feet.

Ew - Weches Formation (Eocene)

Greensand, sand, and clay; greensand mostly glauconite, in part marly, quartz sand common, pale green to yellowish brown; interbedded clay, silty, glauconitic, dark brown to chocolate brown; weathers light to dark reddish brown; thickness 30± feet.

Eqc - Queen City Sand (Eocene)

Sandstone and siltstone; sandstone fine to medium grained, well sorted, noncalcareous, friable to indurated, commonly massive, may be finely laminated, crossbedded, light gray to yellow-orange; siltstone, light gray, friable, thin interbeds of clay, sandy, silty, light gray to olive green; weathers

mottled red and white; thickness 250-500 feet.

Er - Reklaw Formation (Eocene)

Sandstone and clay; sandstone, fine to medium grained, abundant hematite, muscovite, and glauconite, friable to highly indurated, thin bedded to massive, well developed crossbedding, some pelecypod casts; clay, silty, lignitic, chocolate brown to light gray, weathers moderate brown and dark yellowish orange; thickness 50± feet.

Ec - Carrizo Sand (Eocene)

Sandstone, medium to very coarse grained up to size of rice, finer grained toward top, poorly sorted, friable to locally indurated, noncalcareous, thick bedded, light yellow to orange and brown; weathers yellowish brown, locally iron-oxide banded; characterized by ridges thickly forested with oak in eastern part of sheet; thickness 140-200 feet, thickens westward. The stippled area shows the site of the postulated astrobleme of Wilson and Wilson (1979), who state: "Breccia" (of Carrizo Sandstone, according to text) "is common over the entire area but some of it may have been reworked in lake deposits ...".

Ewi - Wilcox Group (Eocene)

Mostly mudstone with varying amounts of sandstone and lignite; in uppermost and lowermost parts commonly glauconitic; mudstone, massive to thin bedded, some silt and very fine sand laminae, pale brown to yellowish brown in upper part, medium to dark gray, weathering yellowish gray in lower part; sandstone in upper part, medium to fine grained, light gray to pale yellowish brown, in lower part very fine grained, yellowish brown to moderate brown, lignite mostly near middle; lower boundary not readily mappable because of gradation into Midway Group (contact taken from sources shown on Index to Geologic Mapping); thickness about 440-1200 feet.

Emi - Midway Group (Eocene)

Clay and sand: clay, silty, sandy, silt and sand more abundant upward grading to mudstone and sand of Wilcox Group, light gray to dark gray; sand, glauconitic to very glauconitic in lower part, argillaceous, poorly sorted, phosphatic nodules and pebbles common in lowermost part, weathers to yellow and yellowish-brown soil; thickness about 100-400 feet.

Knm - Navarro Group and Marlbrook Marl, undivided (Upper Cretaceous)

Kknm - Navarro Group and Marlbrook Marl ("upper Taylor marl") undivided (Upper Cretaceous)
Navarro Group and Marlbrook Marl ("upper Taylor marl") undivided, Knm. Upper part—marl, clay, sandstone, and siltstone; marl and clay, glauconitic, contain concretions of limonite and siderite; sandstone, fine grained, and siltstone, yellow brown, contain concretions of hard bluish-gray siliceous limestone 2 to 10 feet in diameter; sandstone beds have little lateral continuity and become more abundant westward; thickness up to 580 feet. Lower part—clay, dominantly montmorillonitic, unctuous, greenish gray to brownish gray; weathers to a very thick, black, clayey soil; thickness 400± feet. Total thickness 980± feet.

Kpg - Pecan Gap Chalk (Upper Cretaceous)

Chalk and chalky marl, more calcareous westward, very light yellow to yellowish brown, weathers to form moderately deep soil, seldom exposed; *Exogyra ponderosa* common; thickness 100-400 feet, thins westward to eastern Medina County where it is overlain by Anacacho Limestone, beyond this point included with Austin Chalk.

Kau - Austin Chalk (Upper Cretaceous)

Chalk and marl; chalk mostly microgranular calcite with minor foraminifera tests and *Inoceramus* prisms, averages about 85 calcium carbonate, ledge forming, grayish white to white; alternates with marl, bentonitic seams locally, recessive, medium gray, sparsely glauconitic, pyrite nodules in part feathered to limonite common, occasional beds with large-scale cross-stratification; locally highly fossiliferous; thickness 350-580 feet, thickens westward.

Digital Environmental Geologic-GIS Map for San Antonio Missions National Historical Park and Vicinity

Environmental Map Unit List

The environmental geologic units present in the digital geologic-GIS data produced for San Antonio Missions National Historical Park, Texas (SAAN) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., A1 - Floodplain). Information about each geologic unit is also presented in the GRI Geologic Unit Information (SAANUNIT) table included with the GRI digital geologic-GIS data. No ages were indicated on the source map.

- [A1](#) - Floodplain
- [A2](#) - Terraces
- [A3](#) - Dissected terrace or dissected terrace edge
- [A4](#) - Undifferentiated alluvium-colluvium
- [A5](#) - Headwardly eroding streams
- [B2](#) - Black soil alluvial plain
- [B3](#) - Dissected black soil alluvial plain
- [B6](#) - Gravel cap
- [C7](#) - Karstic moderately dissected carbonate
- [C11](#) - Chalk
- [G6](#) - Caliche gravel/chalk undifferentiated
- [H4](#) - Sand hills
- [H5](#) - Moderately rolling sand
- [H7](#) - Low-rolling sand
- [J6](#) - Low-rolling sand and mud
- [J8](#) - Sloping sand and mud
- [J9](#) - Moderately rolling sandy mud
- [K1](#) - Moderately dissected calcareous mud
- [K2](#) - Low-rolling calcareous mud
- [K10](#) - Dissected expansive mud
- [L3](#) - Mud-filled depressions
- [L5](#) - Abandoned channel
- [L7](#) - Densely dissected terrain

Environmental Map Unit Descriptions

Descriptions of all geologic map units are presented below. All descriptions from source map: [San Antonio East Llano East Environmental Geology Sheet](#)

A1 - Floodplain

Alluvium, high- to moderate-frequency flooding, aquifer.

A2 - Terraces

Alluvium, low-frequency flooding possible, low slopes, aquifer.

A3 - Dissected terrace or dissected terrace edge

Dissected alluvium, relief and slopes variable, sometimes gullied.

A4 - Undifferentiated alluvium-colluvium

Alluvium and/or colluvium subject to high- to low-frequency flooding.

A5 - Headwardly eroding streams

Headwardly eroding extensions to stream courses, gullies, low relief.

B2 - Black soil alluvial plain

Alluvium, dominantly limestone clasts, slope less than 2 percent, expansive silty or clayey loam soils, aquifer.

B3 - Dissected black soil alluvial plain

Alluvium, dominantly limestone clasts, dissected, slopes up to 20 percent, clay loam and gravelly clay loam soils.

B6 - Gravel cap

Limestone gravel and/or siliceous gravel, slopes less than 5 percent, gravelly sand or sandy loam soil.

C7 - Karstic moderately dissected carbonate

Limestone and dolomite, straight or gently concave slopes of 5 to 15 percent.

C11 - Chalk

Chalk, variable slopes up to 10 percent. local expansive soils, dark clay and clay loam soils.

G6 - Caliche gravel/chalk undifferentiated

Discontinuous calichified gravel veneer, slopes 5 to 8 percent, gravelly clay to clay loams.

H4 - Sand hills

Friable to loose sand, locally iron-cemented, slopes less than 5 percent, sandy to sandy loam soils, recharge region.

H5 - Moderately rolling sand

Friable to loose sand, slopes greater than 3 percent, sandy loam soil, local recharge areas.

H7 - Low-rolling sand

Friable to loose sand, slopes less than 3 percent, sandy loam soil, recharge areas.

J6 - Low-rolling sand and mud

Interbedded sand and mud and sandy mud, gypsiferous, slopes less than 3 percent, loamy soils.

J8 - Sloping sand and mud

Interbedded sand and mud and sandy mud, gypsiferous, slopes greater than 10 percent, loamy soils.

J9 - Moderately rolling sandy mud

Interbedded sand and mud, slopes greater than 3 percent, sandy clay loam.

K1 - Moderately dissected calcareous mud

Calcareous mud, local expansive clay, gullied where silty, slopes 5 to 15 percent, generally steeper below resistant caprock.

K2 - Low-rolling calcareous mud

Calcareous local expansive clay, low slopes usually less than 5 percent.

K10 - Dissected expansive mud

Sandy to clayey mud, locally gypsiferous, slopes 1 to 5 percent, expansive dark clayey soils with microrelief.

L3 - Mud-filled depressions

Undrained or poorly drained depressions containing clay mud or silty mud, clay loam soil.

L5 - Abandoned channel

Abandoned channel or course, mud-filled.

L7 - Densely dissected terrain

Sand and mud, deep gullies, local badlands, slopes up to 25 percent.

Ancillary Source Map Information

The following sections present ancillary source map information associated with sources used for this project.

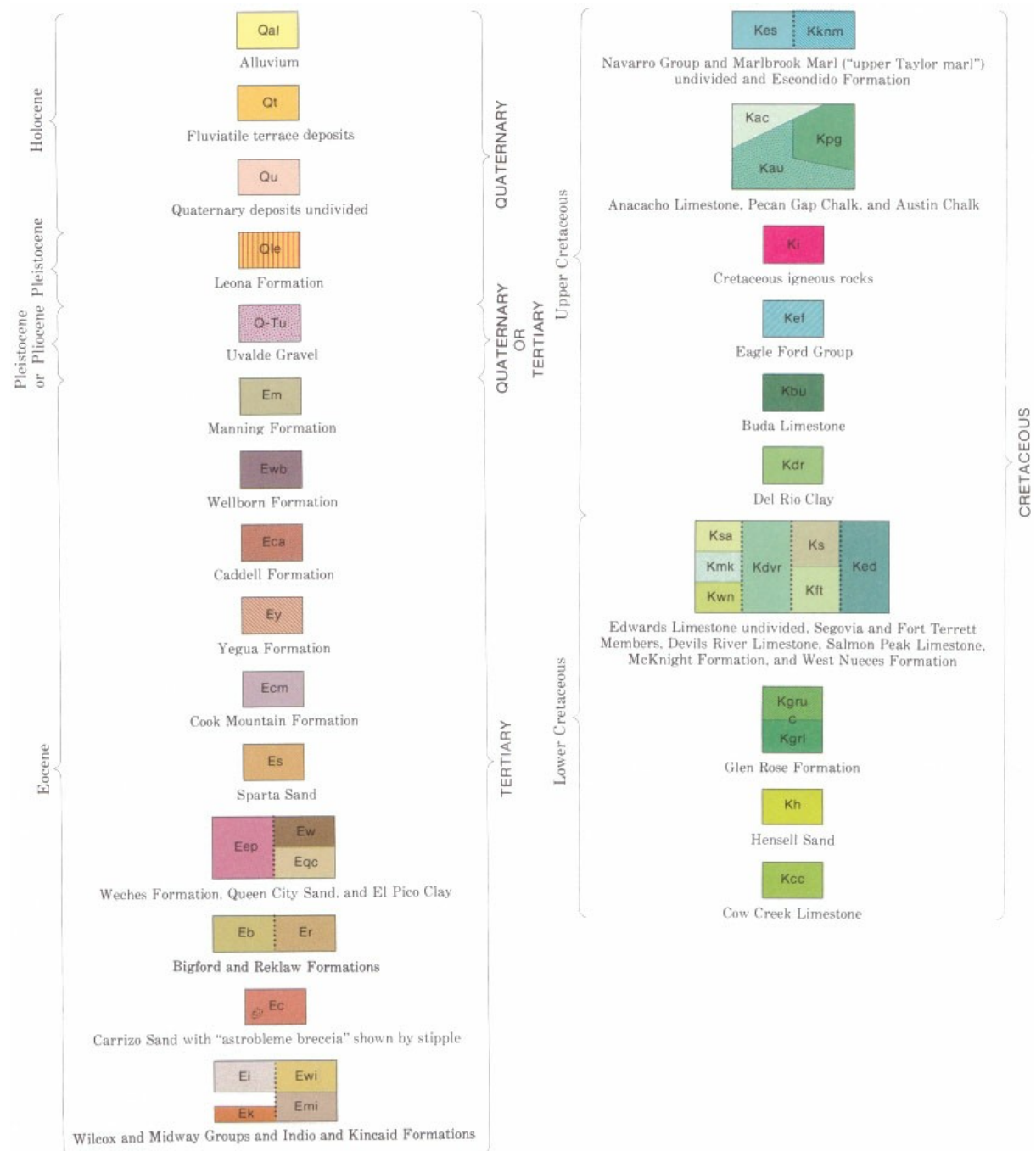
Geologic Atlas of Texas, San Antonio Sheet

The formal citation for this source.

Barnes, V.E., 1982, Geologic Atlas of Texas: San Antonio Sheet (Robert Hamilton Cuyler Memorial Edition): Texas Bureau of Economic Geology, University of Texas at Austin, Geologic Atlas of Texas 29, scale 1:250,000 (*GRI Source Map ID 2879*).

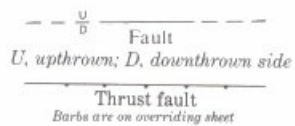
Prominent graphics and text associated with this source.

Correlation of Map Units



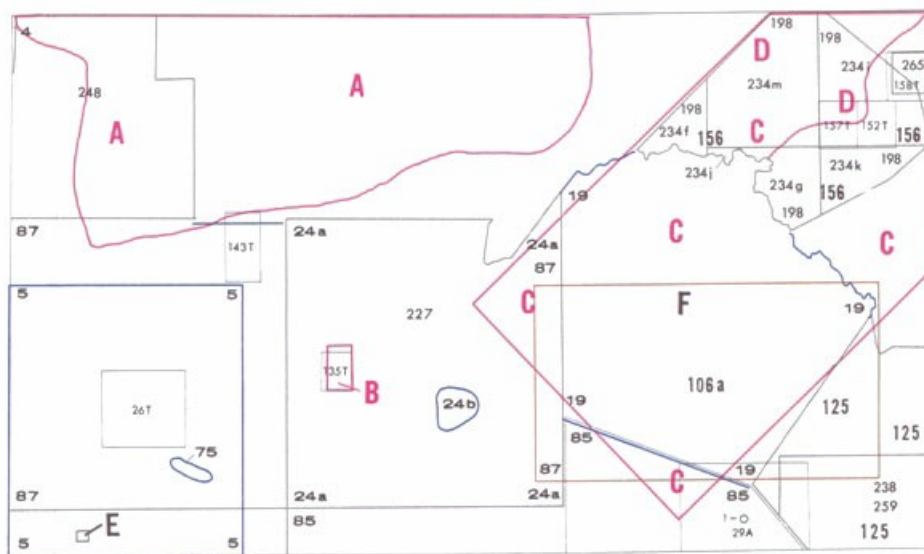
Graphic from source map: [Geologic Atlas of Texas, San Antonio Sheet](#). Note that as the GRI digital geologic-GIS map used only a portion of the full extent of the source map only a subset of units presented above are actually in the GRI digital geologic-GIS map.

Legend



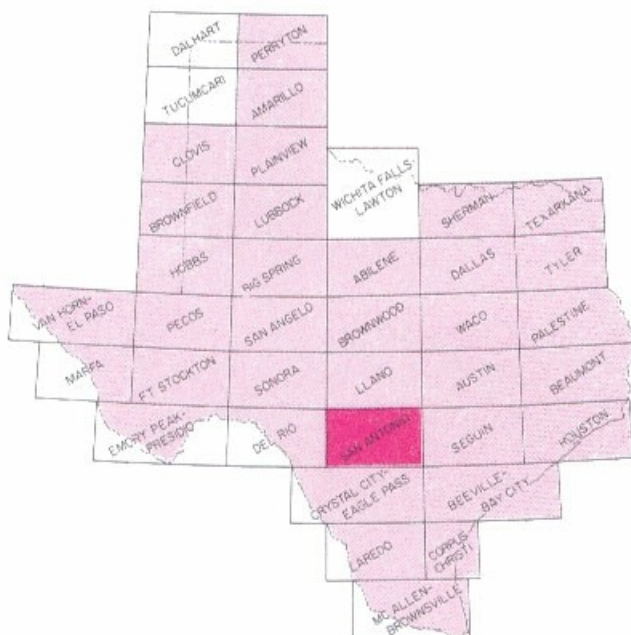
Graphic from source map: [Geologic Atlas of Texas, San Antonio Sheet](#)

Index Map



Graphic from source map: [Geologic Atlas of Texas, San Antonio Sheet](#)

Location Map



Graphic from source map: [Geologic Atlas of Texas, San Antonio Sheet](#)

Map Notes

Virgil E. Barnes, Project Director

Geologic mapping by Shell Development Company, Amerada Petroleum Corporation, Shell Oil Company, T. E. Brown, N. B. Waechter, and sources shown on the Index to Geologic Mapping. T. E. Brown and N. B. Waechter compiled geologic mapping on high-altitude aerial photographs, unmapped areas were compiled photogeologically, and all mapping was field checked except in the Edwards Plateau area.

Upon completion of U.S. Geological Survey 7.5-minute topographic quadrangle mapping for the San Antonio and Crystal City 2-degree sheets, the Quaternary units younger than Uvalde Gravel were remapped. On the basis of topographic expression, the Leona Formation was projected across the San Antonio Sheet into adjacent sheets from its type locality in Uvalde and Zavala Counties. The low terrace deposits, Qat, originally mapped in a separate color, are no longer distinguished from other terrace deposits except by the usual black line between terrace deposits of different ages. The geology of the present edition of the San Antonio Sheet was scribed by R. L. Dillon.

Note, At this point in Blanco County, Captain Robert Hamilton Cuyler, assistant director of the Army Air Forces, Ground Training Technical Advisory Unit, Central Instructors School, Randolph Field, Texas, was killed in an airplane accident on March 13, 1944, while on a training mission. Dr. Cuyler was on leave from the Department of Geology, The University of Texas at Austin, at the time of his death.

Geologic Data for Beaumont Sheet

The formal citation for this source.

Texas Water Development Board, 2007, Geologic Database of Texas: 1:250000 Geologic Data for Beaumont Sheet, Adapted from Barnes, V.E., et al., 1968, Geologic Atlas of Texas, Beaumont Sheet: Texas Bureau of Economic Geology, scale 1:250,000 (*GRI Source Map ID 75030*).

The complete Geologic Database of Texas can be found here: <https://txpub.usgs.gov/txgeology/>

San Antonio East Llano East Environmental Geology Sheet

The formal citation for this source.

Wermund, E.G., et al., 1985, San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, scale 1:250,000 (*GRI Source Map ID 69844*).

Source map directed by E. G. Wermund and T. C. Gustavson, Coordinators of Land Resources Laboratory. Mapped by L. E. Garner, Thomas C. Gustavson, Robert A. Morton, and C. M. Woodruff, Jr. Assisted by Joyce Basciano, Maryann McGraw, Scott Holden, Gwendolyn Macpherson, Scott Griffiths, Bruce Van Allen, and Karen Cortes. Scribing and cartography by Richard Dillon and David M. Ridner.

Prominent graphics and text associated with this source.

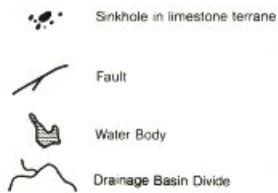
Correlation of Map Units

PROCESS UNITS		FANS	
A1	FLOODPLAIN. Alluvium, high- to moderate-frequency flooding, aquifer.	F1	COARSE ALLUVIAL FAN. Alluvium, locally caliche, slopes up to 10 percent, gravelly loam soil.
A2	TERRACES. Alluvium, low-frequency flooding possible, low slopes, aquifer.	SAND AND GRAVEL	
A3	DISSECTED TERRACE OR DISSECTED TERRACE EDGE. Dissected alluvium, relief and slopes variable, sometimes gullied.	G6	CALICHE GRAVEL/CHALK UNDIFFERENTIATED. Discontinuous caliche gravel veneer, slopes 5 to 8 percent, gravelly clay to clay loams.
A4	UNDIFFERENTIATED ALLUVIUM-COLLUVIUM. Alluvium and/or colluvium subject to high- to low-frequency flooding.	SAND	
A5	HEADWARDLY ERODING STREAMS. Headwardly eroding extensions to stream courses, gullies, low relief.	H4	SAND HILLS. Friable to loose sand, locally iron-cemented, slopes less than 5 percent, sandy to sandy loam soils, recharge region.
ALLUVIAL PLAINS		H5	EOLIAN SAND. Loose wind-deposited sand, local dunes, sandy to sandy loam soils.
B1	ALLUVIAL PLAIN. Extensive alluvium, slopes less than 2 percent, loamy soils, aquifer.	H6	MODERATELY ROLLING SAND. Friable to loose sand, slopes greater than 3 percent, sandy loam soil, local recharge areas.
B2	BLACK SOIL ALLUVIAL PLAIN. Alluvium, dominantly limestone clasts, slope less than 2 percent, expansive silty or clayey loam soils, aquifer.	H7	LOW-ROLLING SAND. Friable to loose sand, slopes less than 3 percent, sandy loam soil, recharge areas.
B3	DISSECTED BLACK SOIL ALLUVIAL PLAIN. Alluvium, dominantly limestone clasts, dissected, slopes up to 20 percent, clay loam and gravelly clay loam soils.	H12	STONE LAND. Friable sandstone locally iron cemented, slopes less than 5 percent, thin lithosols.
B6	GRAVEL CAP. Limestone gravel and/or siliceous gravel, slopes less than 5 percent, gravelly sand or sandy loam soil.	SAND AND MUD	
HARD CARBONATE		J6	LOW-ROLLING SAND AND MUD. Interbedded sand and mud and sandy mud, gypsiferous, slopes less than 3 percent, loamy soils.
C2	KARSTIC MODERATELY DISSECTED TERRAIN. Limestone and dolomite, scattered sinkholes, local faulting, joints with deep solution, slopes of 5 to 15 percent.	J7	MODERATELY ROLLING SAND AND MUD. Interbedded sand and mud and sandy mud, slopes 3 to 10 percent, loamy soils.
C3	KARSTIC LOWLAND. Limestone and dolomite, scattered sinkholes, moderate faulting, joints with deep solution, slopes less than 10 percent.	J8	SLOPING SAND AND MUD. Interbedded sand and mud and sandy mud, gypsiferous, slopes greater than 10 percent, loamy soils.
C4	UPLAND ROLLING CARBONATE. Limestone and dolomite, sinkholes absent, slopes less than 5 percent.	J9	MODERATELY ROLLING SANDY MUD. Interbedded sand and mud, slopes greater than 3 percent, sandy clay loam.
C5	LOW-ROLLING CARBONATE. Limestone and dolomite, sinkholes absent, slopes less than 5 percent.	MUD	
C6	DENSELY DISSECTED CARBONATE. Limestone and dolomite, alternating resistant limestone and soft limestone, planar or convex slopes generally greater than 10 percent.	K1	MODERATELY DISSECTED CALCAREOUS MUD. Calcareous mud, local expansive clay, gullied where silty, slopes 5 to 15 percent, generally steeper below resistant caprock.
C7	MODERATELY DISSECTED CARBONATE. Limestone and dolomite, straight or gently concave slopes of 5 to 15 percent.	K2	LOW-ROLLING CALCAREOUS MUD. Calcareous local expansive clay, low slopes usually less than 5 percent.
C8	LIMESTONE CAPROCK. Thin limestone caprock generally overlying plastic clay, jointed unstable blocks, slopes less than 5 percent except at cap edge.	K3	PLASTIC CLAY. Light-colored clay, bleaches on weathering, unstable low slopes.
C10	SANDY CARBONATE. Sandy dolomite and limestone, rolling terrain, slopes variable, nearly level to vertical bluffs.	K4	LOW-ROLLING MUD. Mud, gypsiferous, slopes less than 3 percent, silty loam soil, locally expansive clay with microrelief.
C11	CHALK. Chalk, variable slopes up to 10 percent, local expansive soils, dark clay and clay loam soils.	K5	MODERATELY ROLLING MUD. Mud, gypsiferous, slopes greater than 3 percent, silty loam soil, locally expansive clay with microrelief.
ALTERNATING CARBONATE BEDS		K10	DISSECTED EXPANSIVE MUD. Sandy to clayey mud, locally gypsiferous, slopes 1 to 5 percent, expansive dark clayey soils with microrelief.
D1	MODERATELY DISSECTED ALTERNATING BEDS. Resistant limestone, soft marly limestone and rare dolomite, forms stairstep topography, slopes 5 to 15 percent.	OTHER	
D2	LOW-ROLLING ALTERNATING BEDS. Resistant thin limestone, soft marly limestone and rare dolomite, subdued stairstep topography, slopes less than 5 percent.	L1	IRON-CEMENTED UPLANDS. Iron-cemented sand and gravel, slopes less than 10 percent, lithosols.
SHALE		L3	MUD-FILLED DEPRESSIONS. Undrained or poorly drained depressions containing clay mud or silty mud, clay loam soil.
E1	DENSELY DISSECTED SHALE. Silty shale and thin, flaggy, fine-grained sandstone, slopes generally greater than 15 percent.	L5	ABANDONED CHANNEL. Abandoned channel or course, mud-filled.
E2	MODERATELY DISSECTED SHALE. Silty shale and thin, flaggy, fine-grained sandstone, slopes 5 to 15 percent.	L7	DENSELY DISSECTED TERRAIN. Sand and mud, deep gullies, local badlands, slopes up to 25 percent.
E3	LOW-ROLLING SHALE. Silty shale and thin flaggy sandstone, commonly jointed with caliche filling, slopes generally less than 5 percent.		

Graphic from source map: [San Antonio East Llano East Environmental Geology Sheet](#). Note that as

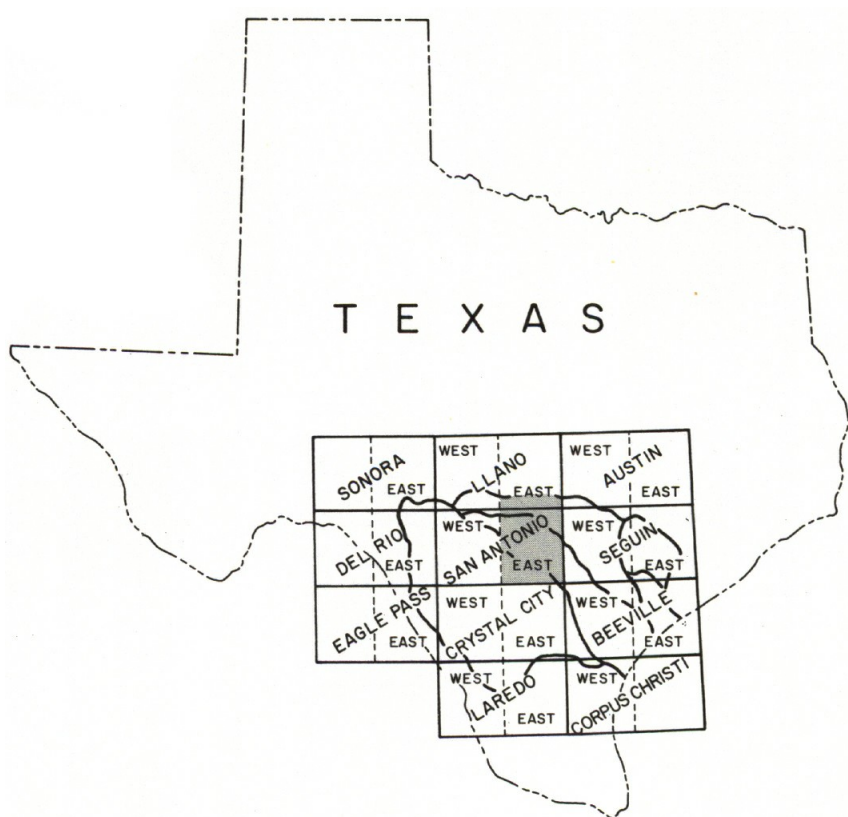
the GRI digital environmental geologic-GIS map used only a portion of the full extent of the source map only a subset of units presented above are actually in the GRI digital environmental geologic-GIS map.

Legend



Graphic from source map: [San Antonio East Llano East Environmental Geology Sheet](#)

Index Map



Report from source map: [San Antonio East Llano East Environmental Geology Sheet](#)

Environmental Geology Working Maps

These are nine working maps for the publication: *Wermund, E.G., Gustavson, T.C., Garner, L.E., Morton, R.A., Woodruff, C.M., Macpherson, G., McKinney, L., Nilsson, J., Waddell, C.T., Basciano, J., and Holden, S., 1985, The Guadalupe - Lavaca - San Antonio - Nueces River Basins Regional Study: San Antonio East – Llano East Environmental Geology Sheet, Bureau of Economic Geology, The University of Texas at Austin, Plate 1, scale 1:100,000 (GRI Source Map 69844).*

These sources were used to digitize the environmental geology at a larger scale for the San Antonio Missions National Historical Park's quadrangles of interest.

Texas Bureau of Economic Geology, 1985, Dewees 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75194*).

Texas Bureau of Economic Geology, 1985, Elmendorf 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75188*).

Texas Bureau of Economic Geology, 1985, Floresville 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75191*).

Texas Bureau of Economic Geology, 1985, Losoya 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75193*).

Texas Bureau of Economic Geology, 1985, San Antonio East 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75186*).

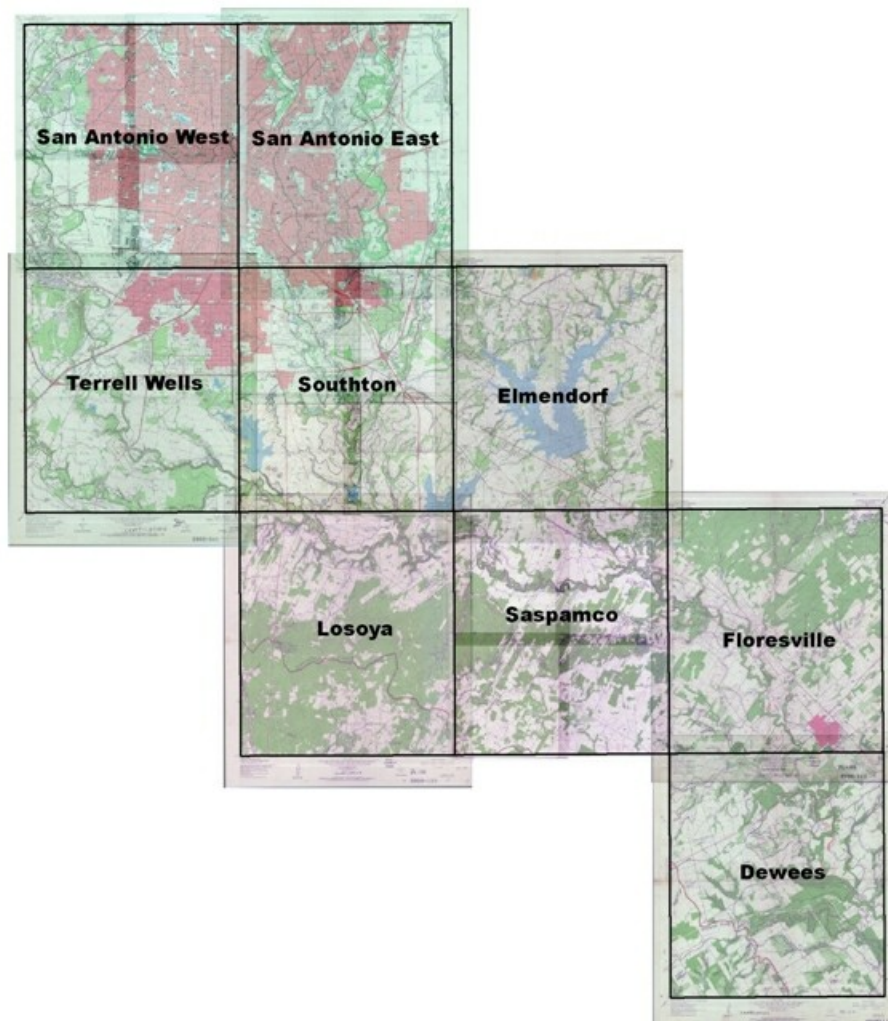
Texas Bureau of Economic Geology, 1985, San Antonio West 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75187*).

Texas Bureau of Economic Geology, 1985, Saspamco 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75192*).

Texas Bureau of Economic Geology, 1985, Southton 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75189*).

Texas Bureau of Economic Geology, 1985, Terrell Wells 7.5' Quadrangle: San Antonio East Llano East Environmental Geology Sheet: Texas Bureau of Economic Geology, University of Texas at Austin, unpublished map, scale 1:24,000 (*GRI Source Map ID 75190*).

Index Map



Graphic created by Andrea Croskrey (NPS GRD, Lakewood, Colorado).

GRI Digital Data Credits

This document was developed and completed by James Winter (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Stephanie O'Meara (Colorado State University).

The information in this document was compiled from GRI source maps, and is intended to accompany the digital geologic-GIS maps and other digital data for San Antonio Missions National Historical Park, Texas (SAAN) developed by Andrea Croskrey (NPS GRD, Lakewood, Colorado), Heather Stanton, Ethan Schaeffer, John Gilbert, James Winter and Stephanie O'Meara (Colorado State University) (see the [GRI Digital Maps and Source Map Citations](#) section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps).

GRI finalization by Stephanie O'Meara and James Winter (Colorado State University).

GRI program coordination and scoping provided by Bruce Heise, Jason Kenworthy and Tim Connors (NPS GRD, Lakewood, Colorado).